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ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

Rate and Spacing in Seeding Crested Wheatgrass in New Mexico

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The general practice for seeding crested wheatgrass (Agropyron cristatum (L.) Gaertn.) on Southwestern ranges is to drill the seed in 12-inch rows at the rate of 6 pounds per acre. Questions have arisen as to what happens if the seeding rate is reduced to 4 pounds. The cost of seeding obviously becomes less, but how satisfactory is the stand of grass? Other questions have been asked about various drill row spacings. For example, what are the results of seeding in 6-inch rows, or 18-inch rows?

Information relating to these questions was obtained from an experiment conducted in northern New Mexico during the period 1951 through 1959.

Literature

Studies conducted by Hull [2] in Idaho showed no differences in yields of crested wheatgrass from drill row spacings of 6, 12, 18, and 24 inches. The 6- and 12-inch rows gave better protection against soil erosion and weed invasion, however, and produced a finer, more palatable forage. Other studies in Idaho[3] indicated that rate of seeding had no effect on the ultimate herbage production of crested wheatgrass. Rates of 2, 4, 8, 12, and 24 pounds per acre were tested. At the end of the third season herbage yield tended to be higher on plots seeded at the heavier rates, but by the end of the eighth season yields were as high for the 2- and 4-pound rates as for the 24-pound rate.

Tests at Fort Valley, Arizona,[4] indicated that the highest seeding rate (12 pounds per acre) produced the greatest yield during years of favorable moisture, but the lowest seeding rate (4 pounds per acre) gave the best yield during dry years. Likewise, the narrowest spacing (6 inches) produced the highest yield in wet years, whereas the widest spacing (18 inches) produced the highest in dry years.

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[2] *Hull, A. C., Jr. Depth, season, and row spacing for planting grasses on southern Idaho range lands. Amer. Soc. Agron. Jour. 40: 960-969, illus. 1948.*

[3] *Mueggler, Walter F. and Blaisdell, James P. Effect of seeding rate upon establishment and yield of crested wheatgrass. Jour. Range Mangt. 8: 74-76. 1955.*

[4] *Lavin, F. and Springfield, H. W. Seeding in the southwestern pine zone for forage improvement and soil protection. U. S. Dept. Agr. Agr. Handb. 98, 52 pp., illus. 1955.*

One study in Colorado[5] showed no differences in yield of crested wheatgrass due to rates of 5 and 10 pounds per acre or to row spacings of 6, 8, 12, and 16 inches. Another study by McGinnies[6] indicated that seeding rates of 2, 3, 6, and 9 pounds per acre had no influence on crested wheatgrass yields. Row spacings, however, did affect his yields. In 1956, a dry year, highest yields resulted from a 21-inch spacing and the lowest from a 7-inch spacing. Yields from a 14-inch spacing were significantly less than from a 21-inch spacing. Similar results were obtained in 1957, a year of average precipitation. Plants at the widest spacing were taller, coarser, and more robust. The trend was from highest yields with narrow row spacings during the first few years after seeding to highest yields with widest row spacings in later years.

Methods of Study

The San Antone experimental site, where this study was conducted, is 19 miles northwest of Tres Piedras, New Mexico, approximately 2 miles inside the Carson National Forest boundary. Before being seeded, the site was dominated by rabbitbrush (Chrysothamnus spp.), black sagebrush (Artemisia nova A. Nels.), and pingue (Hymenoxys richardsonii (Hook.) with scattered plants of slimstem muhly (Muhlenbergia filiculmis Vasey), blue grama (Bouteloua gracilis (H.B.K.) Lag.), bottlebrush squirreltail (Sitanion hystrix (Nutt.) J. G. Smith), and Arizona fescue (Festuca arizonica Vasey). The soil is medium textured, rocky, and shallow. Elevation is about 8,500 feet. Annual precipitation at the nearest U.S. Weather Bureau Station averages nearly 13 inches.

Competing vegetation was removed with a brushland plow in June 1951. Crested wheatgrass was drilled with a single disc grain drill July 10-12, 1951.

Test plots were arranged in a factorial design in two blocks. Three seeding rates, 2, 4, and 6 pounds per acre, were used in combination with three drill row spacings, 6, 12, and 18 inches.

No grazing was permitted until May 1953. Utilization by cattle was comparatively light each spring from May 1 to June 15 in 1953, 1954, and 1955. A fence was built around the experimental plots in April 1956, and no grazing was allowed from 1956 through 1959.

The plots were sampled in 1956, 1957, and 1959.

On July 2, 1956, the plots were sampled for herbage production by clipping 10 random 9.6-square-foot circular samples per plot. On August 16, 1957, the same procedures were used. In addition, 15 crested wheatgrass plants were selected at random on each plot, and basal diameter and compressed culm length were measured.

On June 26-28, 1959, herbage production was sampled on twenty 9.6-square-foot samples per plot. Approximately 175 individual plants in each plot were measured. Because culms had not formed, average maximum compressed leaf length together with basal diameter of each plant were measured. Basal cover of crested wheatgrass was computed from basal diameters and plant counts. Average basal diameter was converted to basal area per plant, then this figure was multiplied by average number of plants to give average basal cover per plot.

Precipitation

Precipitation at Skarda, an official U. S. Weather Bureau station 12 miles from the site, totaled 3.8 inches during August 1951, the month after seeding. Total precipitation in 1952 was 16.3 inches, 3 inches more than the long-term average (table 1). This period of favorable precipitation following seeding no doubt influenced plant establishment and early growth of the grass. But the years 1953 through 1956 were dry; annual precipitation for these 4 years was 33 percent less than average. The year 1956, when yields were

[5] *Hervey, D. F. and Noll, F. E. Reseeding studies. Colo. Agr. Expt. Sta. Gen. Ser. Paper 632, Sect. 3, pp. 5-8. 1955.*

[6] *McGinnies, William J. Effects of planting dates, seeding rates, and row spacings on range seeding results in western Colorado. Jour. Range Mangt. 13: 37-39. 1960.*

Table 1.--Precipitation recorded at Skarda, New Mexico, official U. S. Weather Bureau Station 12 miles southeast of the San Antone experimental site, at 8,500 feet elevation

Interval	Precipitation recorded								
	1952	1953	1954	1955	1956	1957	1958	1959	Long-term average, 1941-60
	Inches								
October through May	9.3	5.6	5.6	5.0	2.3	7.4	10.6	6.0	6.5
October through June	9.6	6.4	5.8	5.0	3.0	7.9	11.0	7.2	7.3
October through July	12.8	10.3	8.2	6.6	4.8	12.9	11.9	7.9	9.5
Total annual	16.3	10.8	7.5	10.2	6.3	20.2	17.8	14.7	13.1

measured for the first time, was especially dry; only 6.3 inches fell, which was less than half the long-term average. In 1957, the second year the plots were sampled, precipitation totaled 20 inches, nearly 60 percent more than average. Precipitation in 1959, the final year the plots were measured, was only 14 percent more than average.

Other studies have shown that, in the area of the study, crested wheatgrass growth is closely related to October-through-May precipitation. At Skarda, precipitation for these months was only about 33 percent of average in 1956, 10 percent more than average in 1957, and 10 percent less than average in 1959. Because the plots were sampled about July 1 in 2 years and in mid-August the other year, summer precipitation probably influenced measurements of the grass. Precipitation from October through June in 1956 was nearly 60 percent less than average, whereas in 1959 it equaled the average. In 1957, when samples were taken August 16, precipitation was 5.0 inches in July and totaled 12.9 inches for October through July. This abundance of moisture explains the exceptional growth and high moisture content of the grass in 1957. Precipitation was more nearly average in 1959 than in the other years of measurement, therefore yield and other plant data obtained that year may approach the average for the site.

Results

Herbage Production

Herbage production of crested wheatgrass varied widely from one year to the next (table 2). The greatest difference in production was from 1956 to 1957. Production figures reflect the extremely dry year (1956) and the unusually wet year (1957). In 1959, both precipitation and crested wheatgrass production were more or less intermediate (fig. 1).

Table 2.--Herbage production of crested wheatgrass for different rates of seeding and drill row spacings for dry year (1956), wet year (1957), and intermediate year (1959)

Drill-row spacings and year	Herbage production at a per-acre seeding rate of--			
	2 lbs.	4 lbs.	6 lbs.	Average
	Pounds per acre			
6-inch:				
1956	50	51	50	50
1957	1,097	1,144	1,035	1,092
1959	418	464	414	432
Average	522	553	500	525
12-inch:				
1956	55	54	55	55
1957	1,174	1,120	1,254	1,183
1959	470	450	446	455
Average	566	541	585	564
18-inch:				
1956	53	52	55	53
1957	1,180	1,216	1,241	1,212
1959	441	454	510	468
Average	558	574	602	578
Combined average:				
1956	53	52	53	53
1957	1,150	1,160	1,177	1,162
1959	443	456	457	452
Overall average	549	556	562	556

6-INCH SPACING

Figure 1.--Plots seeded at 2, 4, and 6 pounds per acre in 1951 and observed in 1959 showed:

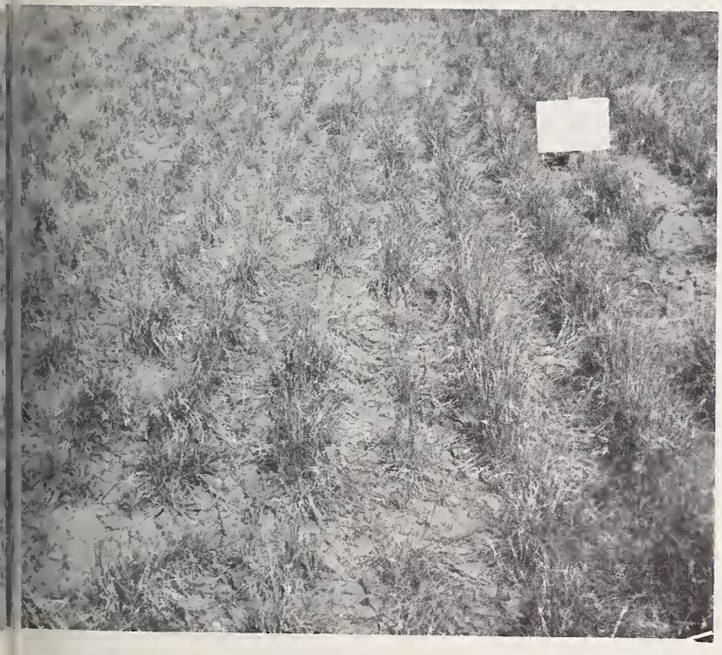
2 LBS. PER ACRE — *about the same except the drill rows were more distinct for the 18-inch spacing*

4 LBS. PER ACRE — *about the same except that drill rows were fairly distinct for both 12- and 18-inch spacing*

6 LBS. PER ACRE — *distinct drill rows and more exposed soil for both 12- and 18-inch spacing*

12-INCH SPACING

18-INCH SPACING



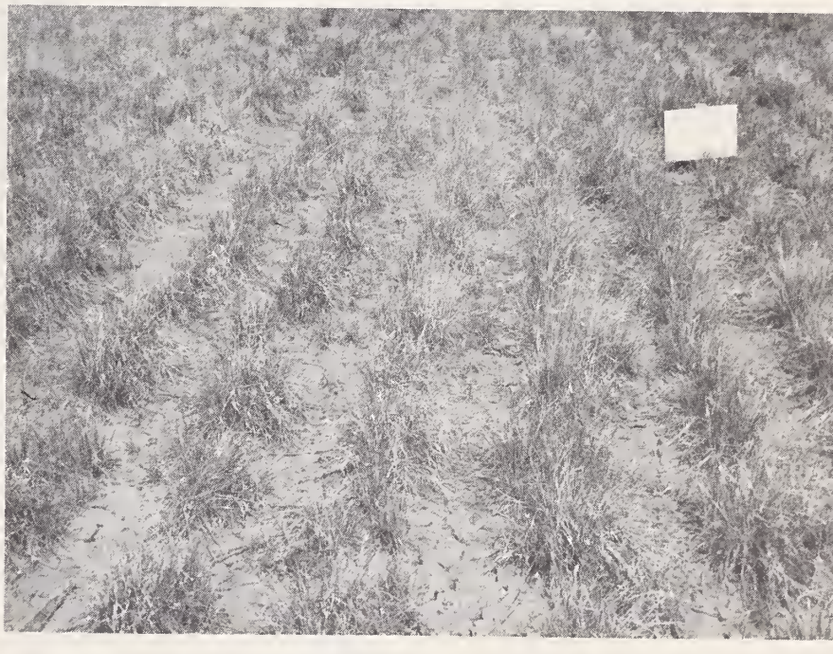


Table 3. --Moisture content of crested wheatgrass herbage from different drill row spacings, for dry year (1956), wet year (1957), and intermediate year (1959)

Drill-row spacings	Date of sampling and moisture content of herbage			
	July 2, 1956	August 16, 1957	June 27, 1959	Average
	- - - - - - - Percent - - - - - - - - -			
6-inch	38.8	60.3	36.8	45.3
12-inch	34.7	61.6	36.9	44.4
18-inch	37.3	63.2	39.3	46.6
Average	36.9	61.7	37.7	45.4

The different drill row spacings had little or no influence on herbage production in the years of measurement. In 1956, when the seeded stands were 5 years old, production was uniformly low. No trend toward higher yield with wider spacing was apparent, although earlier results from Arizona and Colorado had indicated such a trend might be expected in a drought year. In 1957 and 1959, when the stands were in their sixth and eighth years, trends toward higher yields with wider spacings were evident. Because precipitation was above and near average in those years, such trends were not anticipated. These apparent differences in average yields between the 6-, 12-, and 18-inch spacings have little meaning, however, since the only statistically significant difference was between the 6- and 18-inch spacings in 1957.

Likewise, the different rates of seeding did not significantly affect crested wheatgrass production. By the time the stands were 5 years old, yields for the 2-, 4-, and 6-pound rates of seeding were practically the same.

Moisture Content of Herbage

Moisture content of the herbage varied considerably among years, but not among spacings (table 3). Moisture percentages at the time of sampling in 1957 exceeded 60 percent, mainly because precipitation during the previous 9 months was more than in any other year of record. In 1956 and 1959, moisture content for the various spacings averaged 35 to 39 percent.

Number of Plants

Number of plants per square foot in 1959, 8 years after seeding, showed no important differences regardless of seeding rate or spacing (table 4).

Number of plants per square foot showed an inverse relationship to yield of individual plants, as might be expected (fig. 2). Where the stand consisted of only 1.0 plant per square foot, individual plants weighed more than twice as much as where the stand contained 2.5 plants per foot.

Other attributes measured

No real differences were found in either 1957 or 1959 among culm and leaf lengths, basal diameters, or basal cover, regardless

Table 4. -- Number of crested wheatgrass plants per square foot for different rates of seeding and drill row spacings in 1959

Drill-row spacings	Plants per square foot at a per-acre seeding rate of--			
	2 lbs.	4 lbs.	6 lbs.	Average
	- - - - Number - - - -			
6-inch	1.8	2.1	1.8	1.9
12-inch	1.5	2.5	1.6	1.9
18-inch	1.8	1.7	1.4	1.6
Average	1.7	2.1	1.6	1.8

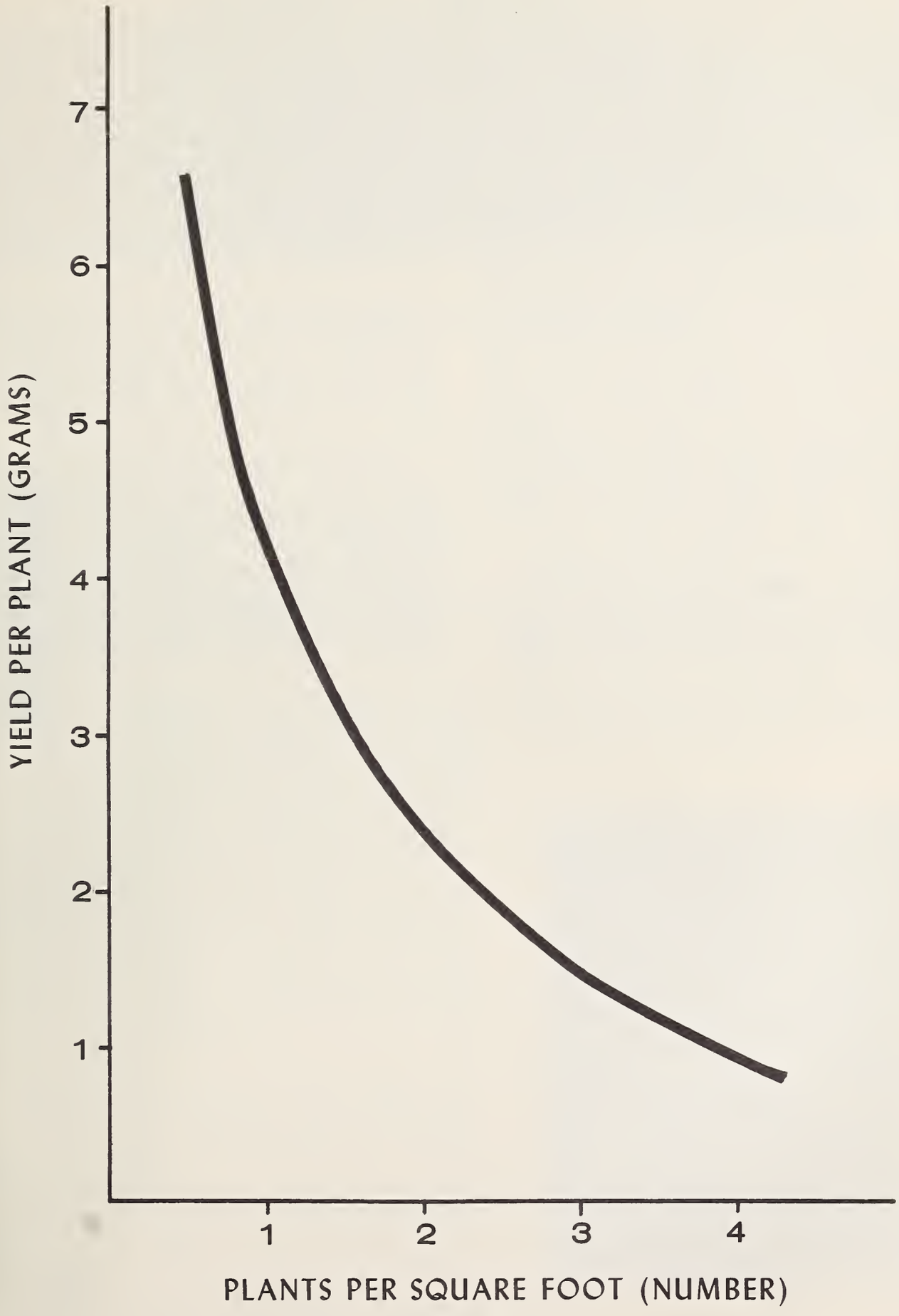


Figure 2.--Relationship between number of plants per square foot and air-dry herbage yield per plant in 1959.

of seeding rate or row spacing. Several differences in the numerical averages were indicated, but none of the differences were statistically significant.

Discussion and Conclusions

This experiment in New Mexico, in common with a number of experiments in other States, indicates that crested wheatgrass stands will reach an equilibrium with the environment within 5 to 8 years, regardless of rate of seeding or drill row spacing. Herbage yields were essentially the same for the 2-, 4-, and 6-pound per acre seeding rates and for the 6-, 12-, and 18-inch row spacing in the fifth, sixth, and eighth years after seeding. Contrary to findings from studies in Arizona and Colorado, no trend was found toward higher yield with wider spacing during a drought year.

Number of plants per square foot in the eighth year after seeding was about the same, regardless of spacing or seeding rate. Apparently, there were death losses resulting from competition among plants in the drill rows, drought, and other factors for the heavier seeding rates. These losses appeared to have been balanced by better survival and establishment of new plants for the lighter seeding rates. In fact, the stands tend to be much alike regardless of seeding rate or row spacing, although drill rows generally were more evident in the wider spacings in 1959 (fig. 1).

From the standpoints of both range and watershed management, the important fact is that plant cover in the eighth year after seeding was practically the same regardless of drill row spacing and rate of seeding.

These results suggest that drill row spacings are not critical, and that seeding rates below the usual 6-pound-per-acre rate may be used to cut down seed costs. The 2-pound rate may result in a slowly developing stand except under favorable conditions of soil preparation, seeding, and weather. The 4-pound rate, however, seems worthy of trial.

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